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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/05500	**15 June 2000**	**2 July 1999**

TITLE OF INVENTION
Diagnosis Method And Diagnosis System For Monitoring The Available Resources In A Production Process

APPLICANT(S) FOR DO/EO/US
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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1.	X	This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.		
2.		This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U S C. 371		
3.	X	This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay Examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).		
4.	X	A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.		
5.	X	A copy of the International Application as filed (35 U.S.C 371(c)(2)).		
		a.		is transmitted herewith (required only if not transmitted by the International Bureau).
		b	X	has been transmitted by the International Bureau **(Form PCT/IB/308)**
		c.		is not required, as the application was filed in the United States Receiving Office (RO/US)
6.	X	A translation of the International Application into English (35 U S C. 371(c)(2)).		
7.	X	Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))		
		a.		are transmitted herewith (required only if not transmitted by the International Bureau)
		b.		have been transmitted by the International Bureau.
		c.		have not been made, however, the time limit for making such amendments has NOT expired.
		d	X	have not been made and will not be made.
8.		A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).		
9.	X	An oath or declaration of the inventor(s) (35 U S C. 371(c)(4)) **(unexecuted)**		
10.		A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).		

Item 11. to 16. below concern other document(s) or information included:

11	X	An Information Disclosure Statement under 37 CFR 1 97 and 1.98.
12.		An assignment document for recording A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13.		A FIRST preliminary amendment.
		A SECOND or SUBSEQUENT preliminary amendment
14.		A substitute specification and marked-up copy thereof.
15.		A change of power of attorney and/or address letter
16.		Other items or information:

a. **Three sheets of drawings (Figures 1-3).**
b. PCT/IB/308
c.

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17. [X] The following fees are submitted:				CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO			$ 890.00	$890.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482)			$ 690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)			$ 740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37CFR 1.445(a)(2) paid to USPTO			$ 1000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)			$ 100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =				$890.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [X] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				$130.00	
Claims	Number Filed	Number Extra	Rate		
Total Claims	8 - 20 =	0	X $18.00	$	
Independent Claims	2 - 3 =	0	X $84.00	$	
Multiple dependent claims(s) (if applicable)			+ $280.00	$	
TOTAL OF ABOVE CALCULATIONS=				$1,020.00	
Applicant claims Small Entity Status (See 37 CFR §1.27) [ ] yes [ ] no. Reduction by 1/2 for filing by small entity, if applicable.				$	
SUBTOTAL =				$1,020.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				$1,020.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28,3.31). $40.00 per property +				$	
TOTAL FEE ENCLOSED =				$1,020.00	
				Amount to be: refunded	$
				Charged	$

a. [X] One check in the amount of $1,020.00 for the filing fee is enclosed

b. [ ] Please charge my Deposit Account No. ______ in the amount of $______ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees, which may be required, or credit any overpayment to Deposit Account No. 05-1323 **(Attorney Docket No. 225/50818).** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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Diagnosis method and diagnosis system for monitoring the available resources in a production process

The invention relates to a diagnosis method for monitoring the available resources in a production process and to a diagnosis system with the aid of which this method can be implemented.

The production of complex products by a system provider takes place in a hierarchical production process in which a large number of different resources in the form of raw materials, semifinished products, components and services are required in the successive stages of production. These resources are procured by the system provider from supply links, it being possible on the one hand for these supply links to be in-house suppliers but on the other hand for them also to be outside suppliers. To avoid capacity shortages in the supplies to the system provider, resources in the form of reserves and stocks are kept by the supply links, tying up a considerable proportion of capital. If these stocks become too great, the tied-up capital causes unnecessary costs; if the stocks become too low, on the other hand, delivery dates cannot be met, in particular when there are fluctuations in demand, as a result of which losses likewise arise. There is therefore a great need to optimize the available resources in the production process in such a way that the costs associated with them are minimized.

Conventional production planning and control systems deal with the questions and planning tasks arising during the design of the production process in a cascading procedure. This produces a static appraisal of the operations. Successful use of an integrated overall system for describing and planning the production process presupposes that all the data necessary for monitoring the production process can be made available at any time. This comprises not only continuous monitoring of the reserves and stocks of all the supply links involved in the production process, but in particular also data concerning

the design of the production and logistical processes, capacity utilization etc. of each individual supply link.

To obtain a realistic picture of the production process in its entirety and its behaviour when fluctuations in demand occur, the individual steps must be treated as parts of an integrated system which comprises the complete production process. Such a planning and diagnosis system, with the aid of which a complex production process can be planned and constantly kept up-to-date for applications within a single company is known, for example, from WO 98/08177.

If, however, the production process also comprises legally independent suppliers operating freely in the market, data which can be continuously called up concerning capacity utilization, production and logistical processes etc. of the supplier are generally not available, since this information forms part of the core know-how of the supplier, which outside parties, in particular other suppliers or competitors - are not permitted to view. Consequently, existing overall systems for describing and planning the production process can be meaningfully used only for planning within a single company and fail if they are distributed among different parties within different companies and if outside suppliers are incorporated.

The invention is therefore based on the object of proposing a diagnosis method which permits continuous monitoring of the available resources in a production process in which outside supply links are incorporated. Furthermore, the invention is based on the object of providing a diagnosis system with the aid of which this diagnosis method can be implemented.

The object is achieved according to the invention by the features of Claims 1 and 7.

Accordingly, the entire network of supply links involved in the production process is replicated in its complexity, with the associated lead times for each individual supply link, in a diagnosis system. The diagnosis system also contains continuously updated data concerning the predicted gross demands and a demand forecast of the system provider, information on the current reserves and stocks of each individual supply link and, for each supply link, an identification number, which is a measure of the responsiveness of the supply link to changes in the demands of the system provider. The diagnosis system in this case replicates a production system operating on the "pull principle", in which the demands of the system provider form the trigger for the entire production chain - and consequently also for each individual supply link.

The predicted demands of the system provider and the information concerning the current reserves and stocks of each supply link are used as a basis to calculate in the diagnosis system, using the identification number of this supply link, whether the current stocks of the supply link concerned are sufficient for the predicted demands of the system provider. The results of this calculation are available at any time to all the supply links - together with the structure and all the lead times of the entire network of supply links. Consequently, each supply link receives from the diagnosis system information on which amounts of the goods provided by it are required at which point in time on the part of the system provider or on the part of other supply links. On the other hand, the supply link learns at which points in the network capacity shortages have occurred and consequently has the possibility of adjusting its own capacities (stocks, capacity utilization etc.) accordingly: for example, if it can see in advance that another supply link, supplying to it, cannot provide the required amounts of raw material, it can possibly look around in time for an alternative supplier. Or it can establish that shortages exist in the case of another

supply link, downstream in its supply chain, for which reason this supply link will request lower sales volumes from the other supply link on the basis of the pull principle, and can cut back its own capacity in time. Each supply link can consequently detect shortages and help in advance to eliminate them. The supply link can also use this information to optimize its stocks, which for the most part result from inadequately coordinated capacities. Since stocks kept by supply links are synonymous with multiple storage of products at different value-adding stages, considerable savings can consequently be achieved in the entire production process.

By simultaneously providing all the information relevant to the system provider and the supply links in the diagnosis system, information flows both in the forward direction and in the backward direction are possible in the network of supply links: the diagnosis system consequently has the function of an early-warning system in the short-term and medium-term periods, which allows all those involved in the network to respond appropriately and in time to local disruptions in the production process. Furthermore, all changes in demand and stocks (for example in the stocks of a supply link) can be fed directly by the system provider and the supply links online into the diagnosis system and consequently be notified simultaneously to all those involved in the production system; this allows phasing-out costs when a model is discontinued to be minimized; furthermore, the launch of a new model on the production system can take place in parallel with models already in production - without great additional effort.

A particularly concise way of representing the supply capability of each supply link is achieved by using a traffic-light function (see Claim 3), in which a supply link is given a "green light" if the stocks kept by this supply link correspond at least to the predicted demand, whereas the supply link is given a "red light" if its stocks are below the predicted demand.

To allow an uninterrupted information flow on the current standing of the supply chain to be ensured - even in the event of a data failure of a supplier - a lead time, which characterizes the time interval between the incoming-goods or outgoing-goods point of this supply link and the assembly site of the system supplier, is expediently determined in advance for each supply link (see Claim 5). This is because, irrespective of the provision of data concerning current stocks by the supply links, it is possible on the basis of the demands of the system provider to calculate using the lead time at any point in time the amounts of reserves, semifinished products etc. which should be present in the stores of the supply links at this point in time.

It is also expedient to use an interpreter list to reference the intermediates supplied by the supply links to the end product produced by the system provider (see Claim 6). This interpreter list ensures the "translation" between the nomenclatures of parts of the supply links and the designation of parts used by the system provider, and ensures that each supply link is informed as to the amounts and types of raw materials and intermediates to be supplied by it, from which the end product is produced by the system provider.

The diagnosis system is expediently accessed via the Internet. In this way it can be ensured that supply links around the world can view the current status of the network at any time and can themselves feed their current data into the information system (see Claim 8).

The diagnosis system consequently ensures the greatest possible transparency of the entire production process and the resources of all the supply links involved in it, it being made possible at the same time for outside supply links to obtain company-internal parameters for themselves. Although the supply link must specify an identification number, which

is a measure of its supply capability (and consequently at least indirectly contains internal process and capacity utilization data), the determination of this identification number is left to each individual supply link itself (see Claim 2). The supply link can consequently make known its supply capability and supply readiness by the choice of its identification number and at the same time retains the greatest possible autonomy.

A range, which is a measure of the time period over which the supply link is capable of balancing out fluctuations in demand of the system provider, is expediently chosen as the identification number of the supply link (see Claim 4). If the supply link indicates a very small range for its supply capability, and consequently presents itself as very "agile", it indicates by this that it can very rapidly adapt its process stage to changed demands of the system provider; however, this involves the risk of the supply link having supply problems if there are strong or medium-term fluctuations in the demand of the system provider, which is expressed by a "red" traffic light. If, on the other hand, the supply link indicates a very large range for its supply capability, this suggests that the supply link has large stocks, which it can use to balance out fluctuations in demand; consequently, its traffic light remains "green" even when there are large changes in the demand of the system provider, but it must be assumed - in particular if ranges are exceedingly high - that the supply link has overdimensioned its store and is consequently keeping considerable dead capital.

Observing the traffic lights, and consequently monitoring the output of the diagnosis method, over a certain period of time therefore gives both the system provider and the supply links valuable indications as to whether, and to what extent, process stages and storage capacities of the supply links can be optimized, in order to ensure a satisfactory supply

capability - with the lowest possible storage costs. An important aspect here is that, in the diagnosis method according to the invention, the system provider primarily assumes the role of an observer and, in particular, need not assume any responsibility for the smooth operation of the supply chain: on the part of the system provider, only the structure of the supply network and continuously updated values for the predicted demand figures are provided; regulating the stocks kept by the supply links is then the responsibility of the supply links themselves. This is an important prerequisite for working together with legally independently operating companies. The diagnosis method consequently describes a self-regulating system in which the supply links choose - on the basis of information made available to them in the diagnosis system by the system provider and the other supply links - their own "optimum operating state" and consequently contribute to the optimization of the entire supply chain. In particular, no optimization of the entire supply network is carried out by the system provider; such wide-ranging optimization would mean a far-reaching intervention into the autonomy of the supply links and would consequently be unacceptable to the majority of the supply links.

However, the diagnosis system allows the system provider to carry out continuous monitoring of shortages in stocks and in particular in supplies in the network of the supply links. Consequently, impending supply shortages among subcontracted suppliers can be detected in the short and medium term. An early response to the shortages increases the delivery capability of the supply chain overall.

The invention is explained below on the basis of an exemplary embodiment represented in the drawings, in which:

Figure 1 shows a schematic representation of a network of supply links involved in a production process,

Figure 2 shows a selected supply chain in the network of the supply links,

Figure 3 shows a representation of the predicted demand of a system provider and the resultant desired stocks which must be kept by the supply links.

Figure 1 shows a representation of a production process in which raw materials, semifinished products and system components from which an end product is produced by a system provider 3 are provided by a network 1 of supply links 2. Each supply link 2 in this network 1 is represented in Figure 1 in the form of a small box; the arrows between the boxes indicate the direction of supply between the supply links 2. The term "supply link" refers here not only to production plants for raw materials, semifinished products or system components, but also to service providers, such as transport agents 4 for example (the boxes of which are shown with a light-grey background in Figure 1). The supply links 2 jointly supply to the system provider 3, which represents the final link of the network 1. The majority of the supply links 2 within the network 1 are interconnected in a manner in which they are dependent on one another in the form of supply chains 5, a supply link 2 respectively supplying goods to the supply link 2' following it in the supply sequence. An example of supply links 2 which together represent such a supply chain 5 is shown hatched in Figure 1.

Figure 2 shows an actual example of a supply chain 5 made up of a plurality of supply links 2: this concerns the production process of leather components, which are assembled by the system provider 3 as part of a door lining of a car. The supply chain 5 comprises three production plants 6, 7, 9, two of which (production plant 6 (leather cutting to size) and 7 (leather sewing)) are located in South Africa and one of which (production plant 9 (door lining part-assembly)) is located in

Germany. Furthermore, the supply chain 5 includes a transport company 8, which transports the semifinished leather products from South Africa to Germany. As shown in Figure 2, each supply link 2 has an input buffer 10, an output buffer 11 and a process stage 12, which may comprise one or more stages of production, transport stages etc. The buffers 10, 11 represent stocks and serve the purpose of at least partly decoupling the material flow between the other supply links 2 located in the supply chain 5. For example, the input buffer 10' of the production plant 9 ensures that the production plant 9 has sufficient semifinished leather products available for the part-assembly of the door lining until the next delivery is made; to be able to assemble door linings even when there are supply difficulties at the production plants 6 and 7 or the transport agent 8, it may be advisable for the production plant 9 to make its input buffer 10' larger. The size of the input buffer 10' of the production plant 9 is consequently dependent to a great extent on how well the production plant 9 is informed about the current state of the production plants 6, 7 and the transport agent 8 supplying to it. The output buffer 11' of the production plant 9 on the other hand ensures that the production plant 9 has sufficient part-assembled door linings available to supply to the system provider 3 even when there are difficulties in its own process stage 12' or if there is increased demand by the system provider 3.

To produce certain numbers of the end product produced by it, the system provider 3 requires certain amounts of the goods or services which have to be supplied to it in time by the supply links 2. The demands of the system provider 3, in their time sequence projected into the future, are encoded - according to the "pull principle" - into demands with respect to each individual supply link 2 in the network 1. To calculate the demands of each individual supply link 2, a certain percentage of wastage must be taken into account - at least for some supply links 2 of a supply chain 5 - on account of inadequate

quality; the gross demands of the supply links 2 are therefore generally higher than those demands which would result from a naive calculation back from the demands of the system provider 3, and are all the higher the further away from the end stage of the system provider 3 the supply link 2 concerned is in the supply chain 5.

To calculate the gross demands with respect to each supply link 2, lead times, caused for example by the process stages of the supply links 2, must be taken into account. Figure 3 shows a diagram of the predicted demands of the system provider 3 with respect to a specific supply link 2' in its time sequence. B_0 designates here the amount of the semifinished product provided (at an earlier point in time) by supply link 2', which is being assembled at the current point in time t_0 by the system provider 3. If δ designates the lead time of the supply link 2' in its supply chain 5, the supply link 2' must be able at the present point in time t_0 to supply an amount B_1 of the semifinished product to allow the demand of the system provider 3 for semifinished product (or the components provided from it by other supply links) to be covered at the later point in time $t_1 = t_0 + \delta$. The lead time δ of the supply link 2' corresponds to the average time interval between the outgoing-goods point at the supply link 2' and the assembly site at the system provider 3'.

The gross demand B_1 is then taken as a basis for determining for the supply link 2' a desired stock, which must be available at the current point in time t_0 in the output buffer 11' of the supply link 2' in order to supply properly to the supply chain 5 - and consequently ultimately also to the system provider 3. This calculation is performed using the range T of the supply link 2'. The range T is in this case a supply-link-dependent parameter, which each individual supply link 2' determines or estimates itself on the basis of its internal process and storage capacities.

The desired stock in the output buffer 11' of the supply link 2' is then calculated from the total of all the gross demands to be expected in the time period between t_1 and $t_1 + T$:

$$\text{desired stock} = \int_{T_1}^{T_1 + T} \text{gross demand}$$

This desired stock is shown with a grey background in Figure 3.

If the momentary stock of the output buffer 11' of the supply link 2' is less than the desired stock, there is the risk of the supply link 2' being unable at the point in time t_0 to satisfy the demands B_1 required on the part of the system provider at the point in time $t_1 = t_0 + \delta$. Such a discrepancy is covered by a "warning function", whereas an actual stock exceeding the desired stock is referred to as "in order". The range T, by which the supply link 2' characterizes its own buffering and process capacities, consequently has the meaning of a "response time". If the supply link 2' has a process stage 12' with a capacity which is very variable, and consequently can be adjusted quickly to fluctuations in demand, the supply link 2' can characterize itself by a small range T. This is because it is then possible to compensate for a large part of a (time-limited) increase in demand by a temporarily increased utilization of the capacity of the process stage 12' (for example of production), and only a small part of the output buffer 11' is in this case emptied. If, on the other hand, the supply link 2' has a slow-responding process stage 12', fluctuations in demand can only be balanced out with a great time delay; such a supply link 2' must therefore set up a correspondingly large output buffer 11', to be able at any time to supply the required gross demands in time, even if there are fluctuations in demand.

The range T, to be set by each supply link 2' itself, is consequently a measure of the time period over which the

supply link 2' is capable of balancing out fluctuations in demand. If the supply link 2' chooses a long range T, the gross demands are averaged over a long time period T to calculate the desired stock of the output buffer 11'. In this way, fluctuations in demand are averaged out.

By analogy with the determination of the range T for the output buffer 11', a range T' can also be determined for the output buffer 10' of the supply link 2', used for calculating the desired stock of the input buffer 10'.

Provided for the continuous monitoring of the supply capability of the entire network 1 of the supply links 2 is a diagnosis system 13, shown hatched in Figure 2. This diagnosis system 13 contains all the information concerning the interconnection of the supply links 2 and the ranges T, T' of all the supply links 2. In addition, the lead times δ of each supply link 2 are stored in the diagnosis system 13. What is more, the diagnosis system 13 contains current data concerning the predicted demands of the system provider 3 and the stocks of the buffers 10, 11 of all the supply links 2, these data being continuously kept up-to-date. In the diagnosis system 13, the supply capability of each individual supply link 2 is continuously determined from the current demand and stock data by using the ranges T, T' of the supply links 2, in that it is calculated whether or not the stocks of the buffers 10, 11 of the supply link 2 exceed the predicted demands.

The result of this check, and the accompanying "warning function", is notified to each supply link 2 in the network 1; this is indicated in Figure 2 by the broken arrows, which link the diagnosis system 13 to each supply link 2. Each supply link 2 consequently receives from the diagnosis system 13 data/information concerning (potential) supply incapabilities of the other supply links 2 in the network 1. It is then the responsibility of the supply link 2 to draw consequences from

this overall information, in that it adapts its own buffers 10, 11 or process stages 12 and/or takes corresponding action with respect to other supply links 2 on which it is dependent. No planning interventions in the individual plans of the supply links 2 take place on the part of the system provider 3, so that the planning sovereignty of each individual supply link 2 is preserved.

Since the lead times δ of all the supply links 2 are replicated in the diagnosis system 13, each supply link 2' can view the lead times δ of all the other supply links 2. Consequently, the diagnosis system makes the lead times δ and their dependencies on one another transparent for all the supply links 2. If - for example because of a data failure - one of the supply links 2' cannot supply any data concerning its buffers 10, 11, the volumes to be supplied can nevertheless be calculated on the basis of the lead times δ and the demands of the system provider 3 for all the other supply links 2 and made available to these supply links 2. Even in the event of a (local) data failure, the "warning function" therefore operates for all the other supply links 2.

The diagnosis system 13 is expediently implemented as a data processing program on a central computer. The central computer is located for example at the site of the system provider 3, and the supply links 2 expediently access the diagnosis system 13 via the Internet. To ensure that only current supply links 2, involved in the supply network 1, can view the diagnosis system 13 and have rights to enter data on it, access to the Internet page concerned is protected by a password.

The discrepancies between demand and the stock kept by a supply link 2 are expediently visually presented in the diagnosis system 13 in the form of a traffic-light function. Accordingly, the input and output buffers 10, 11 of each supply link 2 are allocated a traffic light, which can

indicate the colours green (for "demand and stocks match") or red (for "demand and stocks are in disparity"). Every supply link 2 can therefore see from the diagnosis system 13 whether and to what extent the supply links 2 ahead of it in the supply chain 5 are capable of meeting future demands. At the same time, the diagnosis system 13 allows the system provider 3 to check along the entire supply network 1 whether the necessary goods can be provided on time by the supply links 2. Furthermore, the traffic-light function offers the supply links 2 reference points for the design of their buffers 10, 11: if the traffic light of a supply link 2 is constantly at "green", the current stock kept by this supply link is continuously above the desired stock; the buffers 10, 11 of this supply link 2 have therefore possibly been chosen to be too large. In this case, this supply link 2 can achieve considerable cost savings by a reduction in its buffers 10, 11. If, however, the traffic lights of many supply links 2 are noticeably often at "red" in one branch 5 of the network 1, this indicates problems of the supply links or could be an indication of an incorrect estimation of the lead times d. In this case, a careful analysis of the dependencies on one another of the supply links 2 in this branch 5 is recommendable.

The reference between the goods to be supplied on the part of a supply link 2 (raw materials, semifinished products) and the end product of the system provider is expediently replicated by using an interpreter list. For example, for the production of a door lining which bears the part number "13687.99" at the system provider 3, one large cut-to-size piece of leather and three identical small cut-to-size pieces of leather are required as supplied parts. These cut-to-size pieces of leather are designated at the supply link 2 by the part numbers "LZ 3458-7" and "LZ 3469-2". The interpreter list consequently contains the information that, to produce each door lining, one part with the number "LZ 3458-7" and three parts with the number "LZ 3469-2" of the supplier 2 are

required, and these are jointly allocated to the end product with the number "13687.99" of the system provider 3. The interpreter list consequently contains the complete information on the construction of the end product of the system provider 3 from the raw materials, semifinished products and intermediates made available by the supply links 2. The interpreter list forms part of the diagnosis system 13 and allows the exact encoding of the goods and services which are necessary for the production of the end product by the system provider 3.

Up to now a description has been given of the case of an interconnected supply chain 5 in which the supply links 2 supply sequentially in strict dependence. However, the network 1 of the supply links is generally non-linear - as represented in Figure 1 -, so that a supply link 2 is supplied by a number of other supply links 2. Furthermore, a supply link 2 (for example a forwarding agent) may also be represented a number of times in a single supply chain and/or may be represented simultaneously in a number of different supply chains 5 (for example supply link 4 in Figure 1). In this case, the supply link 2 must optimize (internally) the design of all the buffers 10, 11 and the capacity utilization of all its process stages 12 in such a way that it is capable of satisfying simultaneously all the demands placed on it by the system provider 3. Finally, the semifinished products provided by a supply link may also be assembled on the part of the system provider 3 at a number of different production sites 3', so that - as represented by broken lines in Figure 1 - the semifinished products are delivered not only to the system provider 3 itself, but also to other sites 3'.

Translation of PCT/EP00/05500
Attorney Docket No. 225/50818

Patent claims

1. Diagnosis method for monitoring the available resources in a production process with supply links, which comprise in particular production plants and/or service providers,
   - in which components are supplied by a number of supply links (2, 2', 4) to a system provider (3), which puts these components together to form a system,
   - in which any number of supply links (2, 2', 4) are situated in relation to one another in an interconnected supply chain (5), so that they are in turn supplied by other supply links (2, 2', 4),
   - each supply link (2, 2', 4) having an input buffer (10, 10'), an output buffer (11, 11') and a process stage (12, 12'),

   the diagnosis method comprising the steps
   - that firstly an identification number is determined for each supply stage (2, 2', 4) on the basis of the design of its buffers (10, 10', 11, 11') and its process stage (12, 12'),
   - that information concerning the predicted demands of the system provider (3) in their time sequence is made available by the system provider (3) continually over time to each supply link (2, 2', 4),
   - that information concerning the momentary stock of its buffers (10, 10', 11, 11') is supplied continually over time by each supply link (2, 2', 4),
   - that the identification numbers of the supply links (2, 2', 4) are used to determine continually over time whether their momentary buffer stocks (10, 10', 11, 11') satisfy the predicted demands of the system provider (3),
   - and that the results of this assessment are made available continually over time to the supply links (2, 2', 4).

2. Diagnosis method according to Claim 1, characterized in that the identification number of a supply link (2, 2', 4) is determined by this supply link (2, 2', 4) itself.

3. Diagnosis method according to Claim 1, characterized in that the results of this assessment are made available to the supply links (2, 2', 4) in the form of a traffic-light function.

4. Diagnosis method according to Claim 1, characterized in that a range (T), which is a measure of the time period over which the supply link (2, 2', 4) is capable of balancing out demand fluctuations of the system provider (3), is chosen as the identification number for the determination of the supply capability of the supply link (2, 2', 4).

5. Diagnosis method according to Claim 1, characterized in that a lead time δ, which corresponds to the time interval between the input buffer (10, 10') or output buffer (11, 11') of the supply link (2, 2') and the input buffer (10'') of the system provider (3), is determined for each supply link (2, 2').

6. Diagnosis method according to Claim 1, characterized in that an interpreter list, which contains the reference of the intermediates produced by the particular supply link (2, 2') to the end product of the system provider (3), is created for each supply link (2, 2').

7. Diagnosis system for monitoring the available resources in a production process,
   - a network (1) of supply links (2, 2', 4) which supply to a system provider (3) being involved in the production process,

- each supply link (2, 2', 4) having an input buffer (10, 10'), an output buffer (11, 11') and a process stage (12, 12'),
- and any number of the supply links (2, 2', 4) being situated in relation to one another in an interconnected supply chain (5),

- the diagnosis system (13)
  - replicating the interconnection of the supply links (2, 2', 4) with respect to one another,
  - and also containing data concerning predicted demands of the system provider (3) and also identification numbers and data concerning momentary buffer stocks (10, 10', 11, 11') of all the supply links (2, 2', 4),
- and it being possible for the data contained in the diagnosis system (13) to be called up by the system provider (3) and all the supply links (2, 2', 4).

8. Diagnosis system according to Claim 7, characterized in that the diagnosis system (13) is accessible to the supply links (2, 2', 4) via the Internet.

Abstract

The invention relates to a diagnosis method which permits continuous monitoring of the available resources in a production process, into which a number of supply links are incorporated in the form of a network and supply a system provider or other supply links with raw materials, semifinished products, components and services. Each supply link has an input buffer, an output buffer and a process stage, on the basis of the design of which the supply link determines an identification number which characterizes the operating state of this supply link. The predicted demands of the system provider and the current reserves in the buffers of each supply link are used as a basis to calculate - using the identification numbers of the supply links - for each supply link whether its reserves satisfy the predicted demands of the system provider, i.e. whether it is capable of supplying. Deficits in the stocks of a supply link are notified to all the other supply links, so that a high transparency of the current state of the resources in the supply network is achieved without the supply links having to disclose internal matters concerning their processes. The method is suitable in particular for monitoring resources in supply networks into which supply links outside the company are incorporated. This is a decisive difference in comparison with the PPC systems available on market, which do not take into account suppliers and subcontracted suppliers outside the company.

DIAGNOSIS METHOD AND DIAGNOSIS SYSTEM FOR
MONITORING THE AVAILABLE RESOURCES
IN A PRODUCTION PROCESS
DAFERNER, et al.
PCT No.: PCT/EP00/0500
Attorney Docket No 225/50818
Sheet 1 of 3

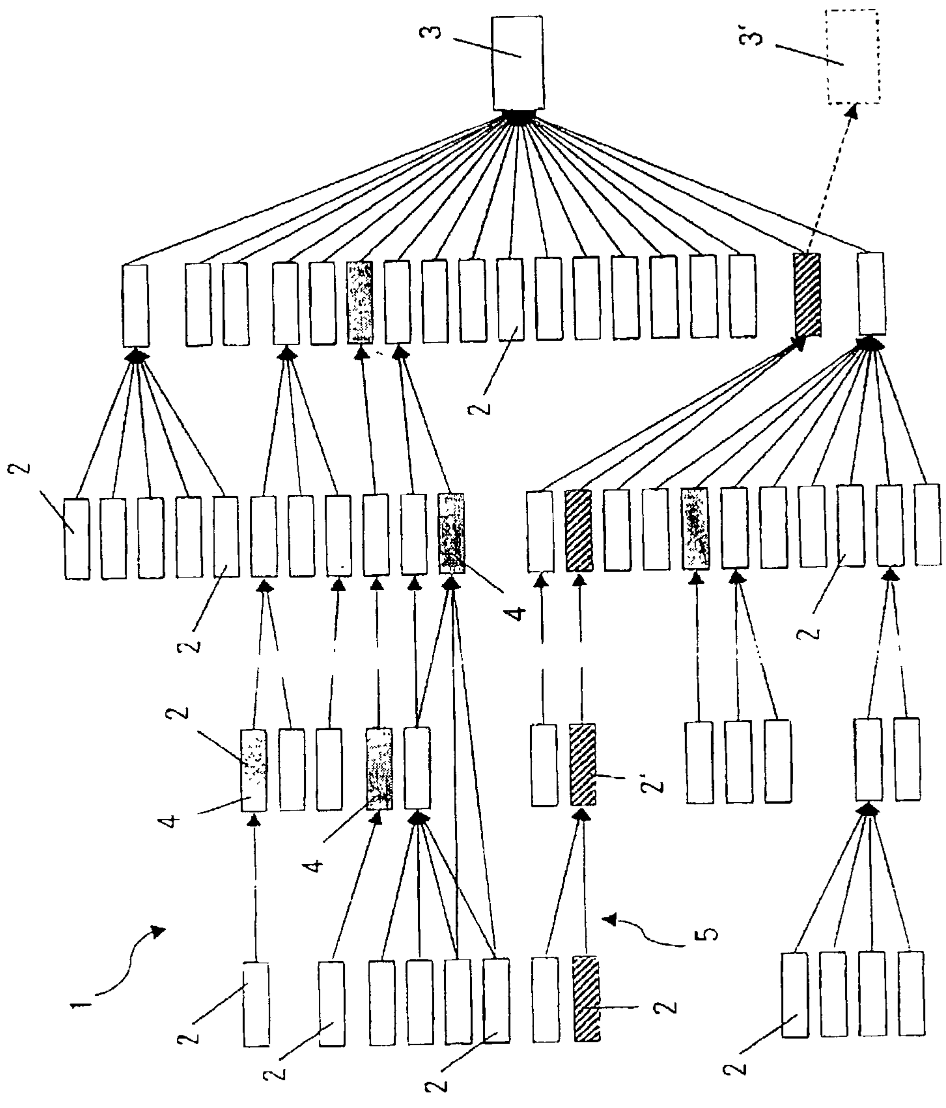

Figure 1

10/019699

DIAGNOSIS METHOD AND DIAGNOSIS SYSTEM FOR
MONITORING THE AVAILABLE RESOURCES
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Sheet 2 of 3

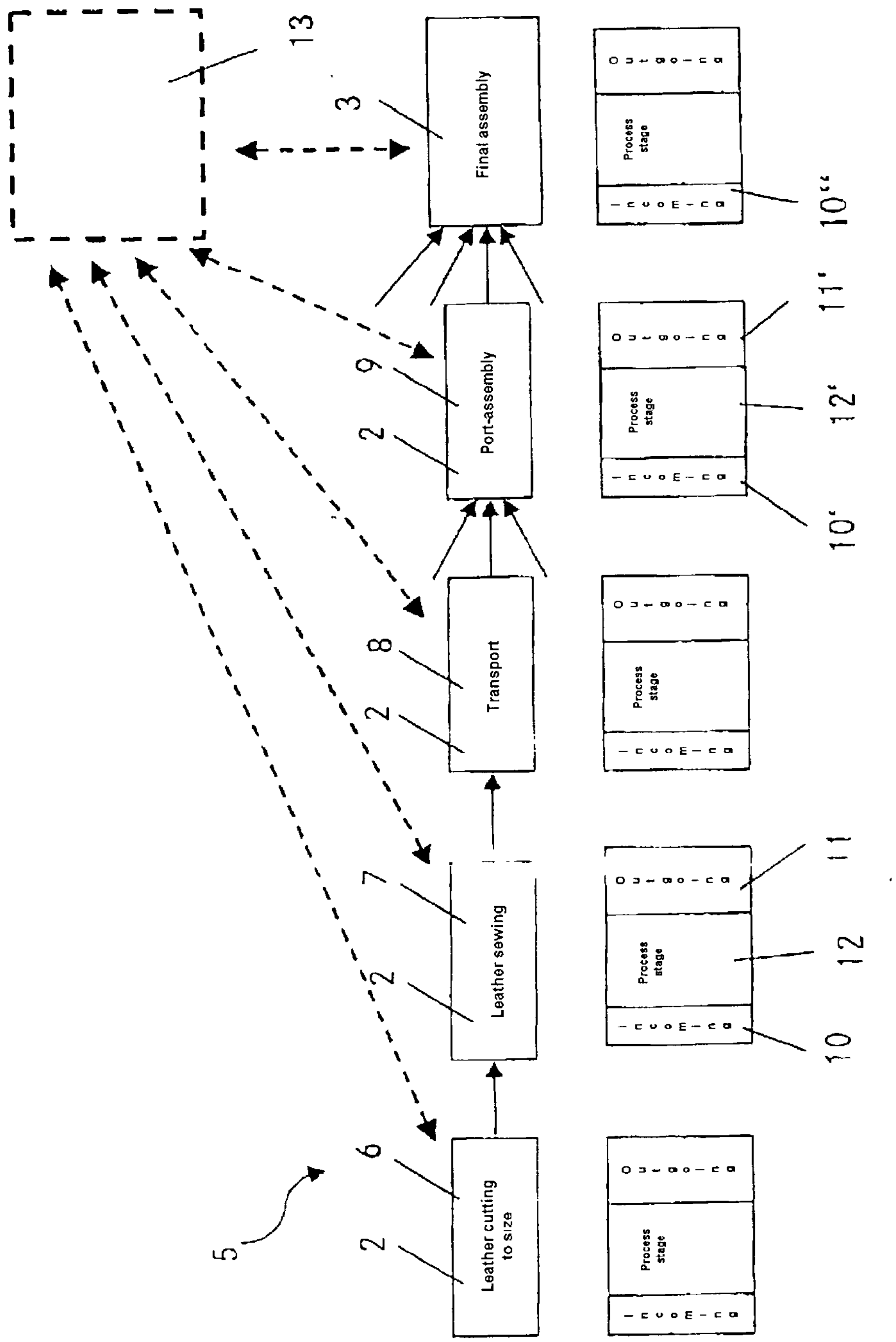

Figure 2

DIAGNOSIS METHOD AND DIAGNOSIS SYSTEM FOR
MONITORING THE AVAILABLE RESOURCES
IN A PRODUCTION PROCESS
DAFERNER, et al.
PCT No.: PCT/EP00/0500
Attorney Docket No. 225/50818
Sheet 3 of 3

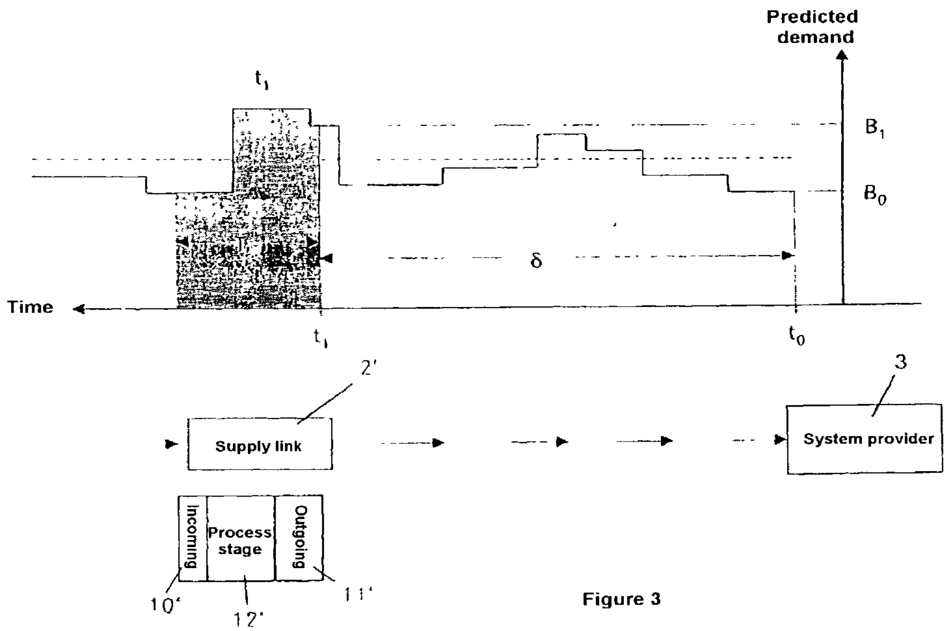

Figure 3

10019699 .050802

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NUMBER 225/50818

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

DIAGNOSIS METHOD AND DIAGNOSIS SYSTEM FOR MONITORING THE AVAILABLE RESOURCES IN A PRODUCTION PROCESS

the specification of which (check only one item below):

[ ] is attached hereto.

[ ] was filed as United States application
Serial No.
on
And was amended
on _______________ (if applicable).

[X] was filed as PCT international application
Number **PCT/EP00/05500**
on **15 June 2000**
and was amended under PCT Article 19
on _______________ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations. §1.56(a).

I hereby claim foreign priority benefits under Title 35, United State Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Germany	199 30 446.7	2 July 1999	[X] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No

10019693 .050602

Combined Declaration For Patent Application and Power of Attorney (Continued) (includes Reference to PCT international Applications)	ATTORNEY'S DOCKET NUMBER **225/50818**

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1 56(a) which occurred between the filing date of the prior application(s) and the national of PCT international filing date of this application

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U S. FOR BENEFIT UNDER 35 U.S.C. 120

U S APPLICATIONS		STATUS (*Check one*)		
U.S APPLICATION NUMBER	U S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (IF ANY)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (List name and registration number)

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203	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
Dafer	Stef Putzlocher	
DATE 7.2.2002	Date 12.2.2002	DATE

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